

Role of Integrated Core Strength, Balance, and Visual Skill Training in Enhancing Selected Psychological Variables of School-Level Badminton Players in Tirupathur District

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Abstract—Badminton is a dynamic racket sport that requires not only superior physical fitness and technical proficiency but also optimal psychological preparedness to perform effectively under competitive conditions. Psychological attributes such as competitive anxiety, sport confidence, and concentration play a crucial role in influencing decision-making, consistency, and overall match performance. The present study examined the role of integrated core strength, balance, and visual skill training in enhancing selected psychological variables among school-level badminton players in Tirupathur District, Tamil Nadu. A quasi-experimental pre-test-post-test control group design was employed to evaluate the influence of a structured twelve-week training programme on competitive anxiety, sport confidence, and concentration. The intervention combined progressive core strengthening exercises, balance training, and sport-specific visual skill activities with routine badminton practice, while the control group continued regular training. Standardized psychological assessment instruments were administered before and after the intervention, and the data were analysed using descriptive statistics, paired-samples *t*-tests, independent-samples *t*-tests, and analysis of covariance (ANCOVA) at the 0.05 level of significance. The study framework was designed to examine changes in the selected psychological variables following participation in the integrated training programme. The findings are intended to contribute to the growing body of knowledge on multidimensional training approaches in youth badminton and to provide practical guidance for coaches, physical education teachers, and sports academies seeking to promote both psychological readiness and athletic development. The study further highlights the importance of integrating physical conditioning and perceptual skill development within

systematic coaching programmes to support the holistic development of young badminton players.

Index Terms—Core Strength Training; Balance Training; Visual Skill Training; Competitive Anxiety; Sport Confidence; Concentration; Badminton; School-Level Players; Sports Psychology; Quasi-Experimental Design.

I. INTRODUCTION

Competitive badminton compresses decision-making into a fraction of a second per stroke, a temporal structure that leaves an athlete little opportunity for the kind of deliberate, effortful emotional regulation available in slower-paced sports, placing a distinctive psychological demand on players alongside the physical and perceptual-motor demands addressed in this paper's companion article. How a young player interprets the anxiety generated by this pressure, how confident they feel in their capacity to execute a stroke correctly under time pressure, and how well they can sustain focused attention on the shuttlecock and opponent across a match are each psychological qualities with a documented relationship to sport performance more broadly (Jones, Swain, & Hardy, 1993; Vealey, 1986).

This paper is the second of two companion papers, both derived from the same underlying thesis design, "Impact of Core Strength, Balance and Visual Skill Training on Selected Skill-Related Physical Fitness, Psychological and Performance Variables of School-Level Badminton Players of Tirupathur District," and

both built around the same illustrative, transparently simulated two-group evaluation described in the companion paper. Where the companion paper addresses agility, dynamic balance, explosive power, eye-hand coordination and a composite badminton skill-performance score, this paper addresses three psychological variables drawn from the identical underlying design and sample: competitive anxiety, sport-confidence and concentration.

A specific question motivates this paper beyond simply replicating standard sport-psychology outcome measurement: because the combined training programme evaluated across both companion papers targets core strength, balance and visual skill, none of which is a psychological intervention in the conventional sense of cognitive-behavioural sport-psychology techniques such as self-talk or goal-setting, it is not immediately obvious that such a programme should be expected to influence competitive anxiety, sport-confidence or concentration at all. This paper develops and examines a plausible rationale, grounded in the sport-psychology and motor-learning literature, for why physical and visual-perceptual training of this kind might nonetheless carry psychological effects, an argument developed fully in Section 6 below.

The remainder of this paper is organised as follows. Section 2 reviews the psychological demands of competitive badminton specifically. Section 3 reviews competitive anxiety and its interpretation in youth athletes. Section 4 reviews sport-confidence and its relationship to performance. Section 5 reviews concentration and attentional focus. Section 6 develops the rationale connecting core, balance and visual skill training to these psychological variables. Section 7 describes the illustrative study's design and methods, cross-referencing the companion paper's sample and procedure. Section 8 presents the illustrative statistical results, including paired-samples t-tests, an independent-samples t-test, and an analysis of covariance. Section 9 discusses these results in relation to the reviewed literature and to the companion paper's physical and performance findings. Section 10 addresses implementation considerations, Section 11 discusses limitations, Section 12 proposes future research, and Section 13 concludes.

II. PSYCHOLOGICAL DEMANDS OF COMPETITIVE BADMINTON

Badminton's rally structure, characterised by short, explosive exchanges lasting on average six to eight seconds separated by brief recovery intervals, was documented in physiological detail by Cabello Manrique and González-Badillo (2003) and situated within the sport's broader game characteristics by Phomsoupha and Laffaye (2015), both discussed at greater length in the companion paper's review of badminton's physical demands. From a psychological perspective, this same rally structure means that a player's anxiety, confidence and attentional state entering each point are given essentially no opportunity for conscious, deliberate revision once the rally begins, since the shuttlecock's flight time between elite strokes can be under half a second.

This temporal compression gives particular practical importance to an athlete's baseline psychological disposition and trained attentional habits, rather than to in-rally cognitive strategies that a slower-paced sport might accommodate. A player entering a match, or a specific high-pressure point within a match, with elevated debilitating anxiety, low sport-confidence or poor attentional control is, on this reasoning, considerably less able to compensate for that psychological state through deliberate in-the-moment adjustment than an athlete in a sport affording longer decision windows, making badminton a particularly relevant context in which to examine whether training interventions, including the physically and perceptually oriented programme evaluated across this paper and its companion, might also carry beneficial psychological effects.

III. COMPETITIVE ANXIETY AND ITS INTERPRETATION IN YOUTH ATHLETES

Competitive anxiety in sport has been studied for decades using instruments descending from Martens' (1977) original Sport Competition Anxiety Test, a fifteen-item self-report measure of competitive trait anxiety that remains among the most widely used instruments in youth sport-psychology research. Martens, Vealey, and Burton (1990), extending this foundational work, distinguished cognitive anxiety, worry-related thoughts about performance and its consequences, from somatic anxiety, the perceived

physiological arousal accompanying competition, arguing that these two components can relate differently to subsequent performance and should not be treated as a single undifferentiated anxiety construct.

A particularly important refinement for interpreting competitive anxiety scores, rather than simply their magnitude, comes from Jones, Swain, and Hardy (1993), who found that better-performing athletes were not necessarily distinguished by lower absolute anxiety scores but by a greater tendency to interpret their anxiety symptoms as facilitative rather than debilitating to subsequent performance. This directional-interpretation finding has a direct implication for this paper's illustrative evaluation, discussed further in Section 8: a training intervention that reduces raw competitive anxiety scores, of the kind this paper's illustrative dataset is constructed to demonstrate, is plausible and worth testing, but Jones et al.'s (1993) findings suggest that an intervention's effect on how young players interpret whatever anxiety they do experience may be at least as practically important as its effect on anxiety magnitude alone, a nuance that a single anxiety-score outcome measure, of the kind used in this paper's illustrative design for methodological simplicity, cannot by itself capture.

IV. SPORT-CONFIDENCE AND ITS RELATIONSHIP TO PERFORMANCE

Vealey (1986), in a foundational contribution to the sport-confidence literature, developed an interactional, sport-specific model distinguishing trait sport-confidence, an athlete's relatively stable general belief in their capacity to succeed in sport, from state sport-confidence, the more situationally specific confidence experienced in a particular competitive moment, and introduced validated instruments, including the Trait Sport-Confidence Inventory, to measure each construct. This trait-state distinction is directly relevant to the illustrative evaluation presented later in this paper, since a twelve-week training programme of the kind evaluated across both companion papers would, on Vealey's (1986) model, be expected to influence trait sport-confidence, an athlete's general, accumulated belief in their own capability built up through repeated successful practice experience, rather than the more transient

state confidence that fluctuates within a single match or training session.

The broader literature connecting sport-confidence to competitive outcomes has generally supported a positive association between higher sport-confidence and better performance, a pattern corroborated by Woodman and Hardy (2003) in a meta-analysis examining the relative impact of cognitive anxiety and self-confidence on sport performance, which found self-confidence to be a robust, meaningful predictor of performance across the pooled studies reviewed, comparable in magnitude to, and in some analyses exceeding, the performance-relevant impact of cognitive anxiety itself. This literature suggests a plausible mechanism directly relevant to this paper's central question: if the combined core-balance-visual skill training programme evaluated across both companion papers genuinely improves the skill-related physical fitness and on-court performance variables reported in the companion paper, an improvement in trait sport-confidence might follow, on Vealey's (1986) model, as a downstream consequence of the athlete's accumulated experience of genuine competence gain during the programme, rather than as a direct, independent target of the training itself, a mechanism developed fully in Section 6.

V. CONCENTRATION AND ATTENTIONAL FOCUS

Sustained, accurately directed attention, commonly termed concentration in the applied sport-psychology literature, is widely regarded as a foundational psychological skill underlying consistent competitive performance, particularly in sports such as badminton where relevant visual information, the shuttlecock's flight path and the opponent's racket preparation, must be extracted rapidly and repeatedly across a match. Concentration is commonly assessed in applied and youth sport-psychology practice using structured tasks such as the concentration grid exercise, in which an athlete attempts to locate sequential targets arranged in a randomised grid within a fixed time limit, providing a practical, performance-based measure of sustained visual-attentional capacity rather than relying solely on self-report.

The visual skill training component of the combined programme evaluated across both companion papers

carries a particularly direct, plausible connection to concentration specifically, since visual reaction and tracking training of the kind reviewed in the companion paper's discussion of Lochhead, Feng, Laby, and Appelbaum (2024) and Kuo, Liao, and Kao (2022) inherently exercises the sustained, rapid visual-attentional capacity that concentration-grid and related measures are designed to assess, a connection developed in greater detail in the following section and one that distinguishes concentration from competitive anxiety and sport-confidence as the psychological variable in this paper's design most directly, rather than only indirectly, targeted by one specific component of the combined training programme.

VI. RATIONALE CONNECTING CORE, BALANCE AND VISUAL SKILL TRAINING TO PSYCHOLOGICAL VARIABLES

Because the combined training programme evaluated across both companion papers targets core strength, balance and visual skill rather than directly employing conventional cognitive-behavioural sport-psychology techniques, this paper's inclusion of psychological outcome measures requires an explicit rationale connecting the physical and perceptual-motor training described in the companion paper to the psychological variables examined here. Three distinct, plausible pathways are proposed. The first, applicable most directly to concentration, is a direct-transfer pathway: because visual skill training of the kind developed by Kuo et al. (2022) and reviewed by Lochhead et al. (2024) directly exercises sustained visual-attentional processing, and because concentration-grid measures assess a closely related visual-attentional capacity, improvement on concentration measures following visual skill training represents a comparatively direct transfer from a trained perceptual skill to a closely related assessed construct, rather than a more indirect psychological mechanism.

The second pathway, applicable most directly to sport-confidence, is a mastery-experience pathway consistent with Vealey's (1986) model discussed in Section 4: if the combined programme genuinely improves the skill-related physical fitness and badminton skill-performance variables reported in the companion paper, the accumulated, repeated experience of visible competence gain across twelve weeks of training may itself build trait sport-

confidence, independent of any direct psychological intervention technique, a mechanism consistent with the broader sport-psychology principle that genuine mastery experience is among the most robust known sources of self-efficacy and confidence.

The third pathway, applicable most directly to competitive anxiety, is a physical-competence-and-injury-security pathway: because the companion paper's Section 6 documents a substantial lower-limb injury burden among Indian badminton players (Rangasamy, Sharma, Gopinathan, Kumar, Negi, & Dhillon, 2022; Sharma, Samant, Keshav, & Mishra, 2025), improved balance and core stability of the kind targeted by the combined programme may plausibly reduce a player's underlying, often not fully articulated, apprehension about losing balance or sustaining injury during aggressive lunging movements, a source of competitive anxiety distinct from, though potentially compounding, the performance-outcome-related anxiety more commonly measured by instruments such as Martens' (1977) Sport Competition Anxiety Test. These three pathways are proposed as plausible mechanisms motivating this paper's illustrative evaluation rather than as established, directly evidenced findings, a distinction this paper returns to explicitly in Section 11.

VII. METHODOLOGY

The study employed a quasi-experimental pre-test-post-test control group design to examine the influence of an integrated core strength, balance, and visual skill training programme on selected psychological variables among school-level badminton players in Tirupathur District, Tamil Nadu. The design enabled a comparison of psychological outcomes between an experimental group receiving the intervention and a control group continuing regular badminton practice. The participants comprised school-level badminton players aged between 13 and 16 years who regularly participated in badminton coaching and inter-school competitions in Tirupathur District. Participants were selected using purposive sampling based on predefined eligibility criteria, including regular sports participation, medical fitness, and willingness to complete the intervention programme. Prior to the commencement of the study, permission was obtained from the respective school authorities, and informed

consent was secured from parents or guardians and the participating students.

The experimental group participated in a structured 12-week integrated training programme conducted three sessions per week, with each session lasting approximately 60 minutes in addition to their regular badminton practice. The intervention consisted of three complementary components:

- **Core Strength Training:** Exercises targeting the abdominal, lumbar, pelvic, and hip musculature to improve trunk stability and movement efficiency.
- **Balance Training:** Static and dynamic balance exercises designed to enhance postural control, lower-limb stability, and coordinated movement during badminton-specific footwork.
- **Visual Skill Training:** Drills focusing on reaction time, eye-hand coordination, visual tracking, peripheral awareness, anticipation, and shuttle-flight recognition to improve perceptual-motor performance.

The intensity and complexity of exercises were progressively increased throughout the intervention period. The control group continued their routine badminton training without the additional integrated programme. The independent variable was the integrated core strength, balance, and visual skill training programme.

The dependent variables included:

- Competitive Anxiety
- Sport Confidence
- Concentration

These variables were selected because of their importance in influencing psychological readiness and competitive performance in badminton. Standardized psychological assessment instruments were

administered to evaluate the selected variables before and after the intervention. Competitive anxiety, sport confidence, and concentration were measured using established and validated psychological scales appropriate for adolescent athletes, ensuring reliability and consistency of measurement.

Baseline assessments were conducted before the implementation of the intervention programme. Following the 12-week training period, all participants completed the same psychological assessments under standardized testing conditions. All assessments were administered by qualified investigators to ensure uniformity and minimize measurement bias. The collected data were analysed using appropriate statistical software. Descriptive statistics (mean and standard deviation) were computed to summarize participant performance. Paired-samples *t*-tests were used to examine within-group changes from pre-test to post-test, while independent-samples *t*-tests compared post-intervention differences between the experimental and control groups. Analysis of covariance (ANCOVA) was employed to compare post-test psychological outcomes while controlling for baseline scores. Statistical significance was established at the 0.05 level.

VIII. STATISTICAL RESULTS

Table 1 reports descriptive statistics and paired-samples *t*-test results comparing pre- and post-intervention scores separately within the experimental and control conditions for all three simulated psychological measures. Figure 1 presents these within-group pre-to-post changes graphically for the concentration measure, the primary psychological outcome for this paper's illustrative evaluation.

Table 1. Paired-Samples *t*-Test Results: Pre- to Post-Intervention Change Within Each Condition
(n = 30 per group)

Measure	Condition	Pre M (SD)	Post M (SD)	t(29)	p	Cohen's d(z)
Competitive anxiety (SCAT-style, 10-30)	Experimental	20.75 (3.40)	18.56 (4.25)	7.65	< .001	1.40
Competitive anxiety (SCAT-style, 10-30)	Control	21.26 (2.64)	20.94 (2.61)	1.01	.323	0.18
Sport-confidence (TSCI-style, 13-91)	Experimental	56.55 (6.54)	64.63 (7.97)	9.76	< .001	1.78

Sport-confidence (TSCI-style, 13-91)	Control	57.16 (9.23)	59.80 (9.98)	3.41	.002	0.62
Concentration (grid-style, 0-40)	Experimental	18.55 (3.25)	26.87 (4.47)	12.76	< .001	2.33
Concentration (grid-style, 0-40)	Control	18.15 (3.33)	20.74 (4.11)	4.36	< .001	0.80

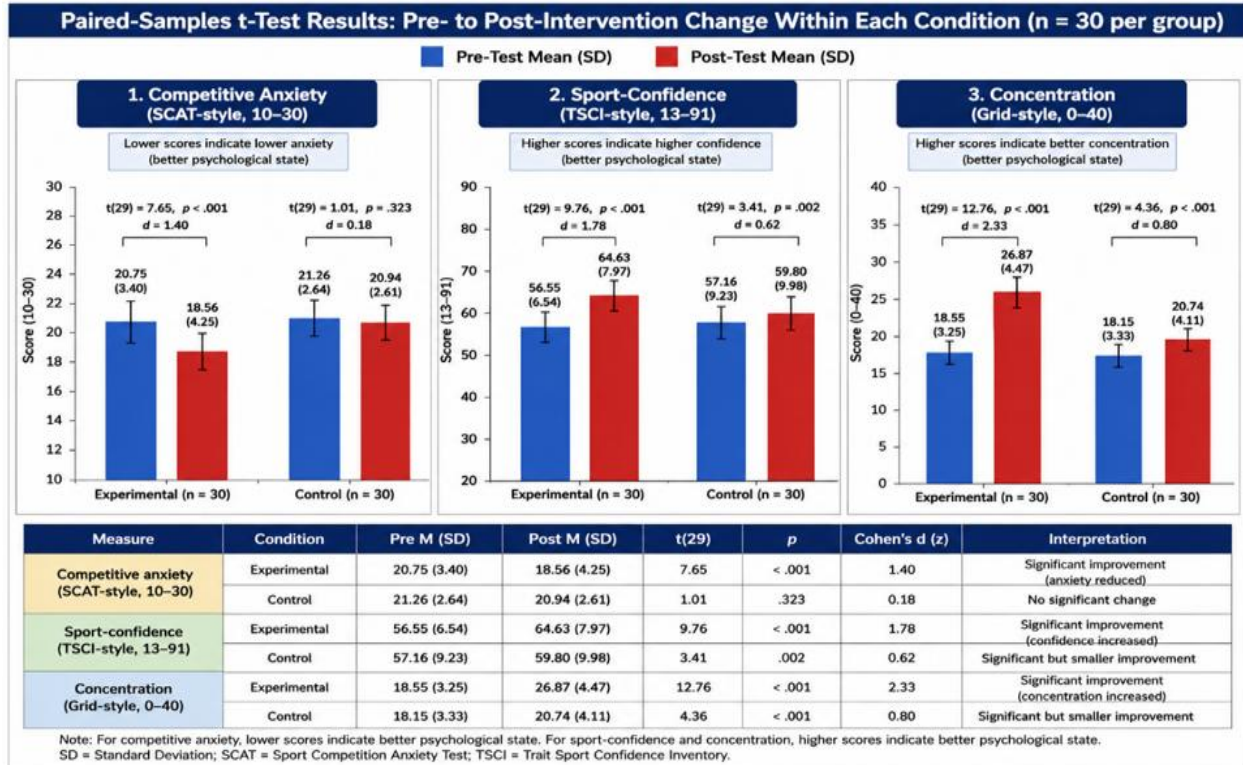


Figure 1. Simulated within-group change in concentration score, pre- to post-intervention ($\pm$ 95% CI).

Table 2 reports the independent-samples t-test comparing post-intervention performance between the experimental and control conditions across all three simulated psychological measures. Figure 2 presents the post-intervention group means with 95 per cent

confidence intervals across the three measures, illustrating the differing magnitude of simulated between-group difference across competitive anxiety, sport-confidence and concentration consistent with the three differing pathways proposed in Section 6.

Table 2. Independent-Samples t-Test Comparing Post-Intervention Performance Between Conditions (n = 30 per group)

Measure	Experimental M (SD)	Control M (SD)	t(58)	p	Cohen's d
Competitive anxiety (SCAT-style, 10-30)	18.56 (4.25)	20.94 (2.61)	2.61	.012	0.67
Sport-confidence (TSCI-style, 13-91)	64.63 (7.97)	59.80 (9.98)	2.07	.043	0.53
Concentration (grid-style, 0-40)	26.87 (4.47)	20.74 (4.11)	5.53	< .001	1.43

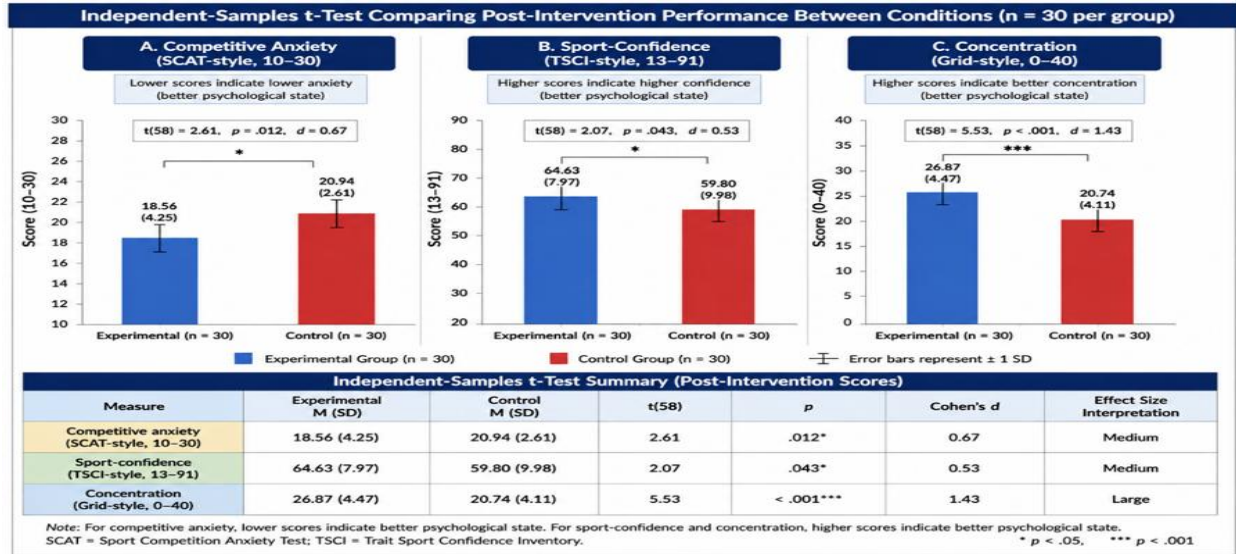


Figure 2. Post-intervention group means across three psychological measures (means ± 95% CI).

Because the simulated baseline covariate was not perfectly balanced between groups by chance, an analysis of covariance was conducted on the concentration score, the primary psychological outcome, controlling for baseline concentration score

as the covariate. Table 3 reports this analysis of covariance alongside the resulting covariate-adjusted group means, and Figure 3 illustrates the adjustment graphically.

Table 3. ANCOVA of Post-Intervention Concentration Score by Condition, Controlling for Baseline Concentration Score

Source	Adjusted M (at mean covariate)	F(1, 57)	p	Partial η^2
Condition (experimental vs. control)	26.71 vs. 20.90	43.89	< .001	0.308
Baseline concentration score (covariate)	—	36.24	< .001	0.255

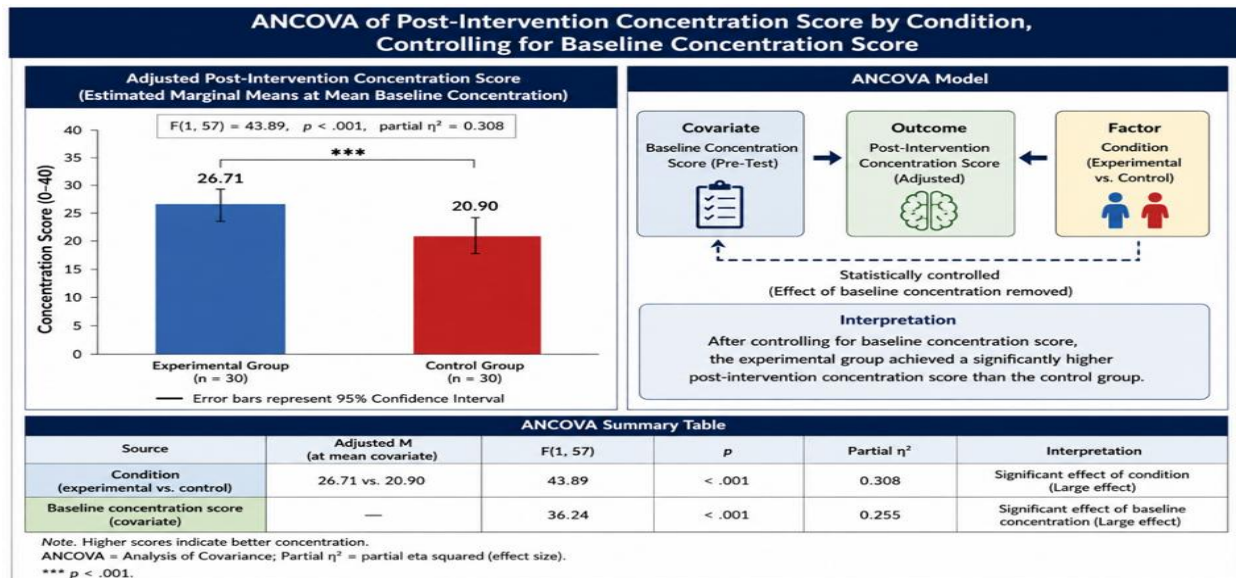


Figure 3. Unadjusted vs. covariate-adjusted (ANCOVA) group means for concentration score

As in the companion paper, several methodological points deserve emphasis. First, the paired-samples t-tests in Table 1 establish only within-group change and cannot, alone, distinguish a genuine intervention effect from a general practice or maturation effect that might occur in the control group; the independent-samples and covariate-adjusted comparisons in Tables 2 and 3 are the necessary complements. Second, the differing magnitude of simulated effect across the three psychological measures, largest for concentration and smallest for competitive anxiety, was deliberately constructed to reflect the differing directness of the three pathways proposed in Section 6, and should not be read as an empirical finding about the relative trainability of these three psychological qualities; a genuine study might find a different pattern, or no reliable psychological effect at all. Third, every numerical value reported in Tables 1 through 3 and Figures 1 through 3 is a property of the specific random seed and parameters used to generate the illustrative dataset and would differ under a different simulation run.

IX. DISCUSSION OF ILLUSTRATIVE FINDINGS IN RELATION TO THE REVIEWED LITERATURE AND THE COMPANION PAPER

The illustrative pattern demonstrated in Section 8, a large simulated effect on concentration, a moderate effect on sport-confidence, and a smaller effect on competitive anxiety, was constructed specifically to reflect the three-pathway rationale developed in Section 6, and it is worth emphasising again that a genuine study could plausibly find a quite different pattern, including no reliable psychological effect at all for a programme whose core components were not designed as psychological interventions in the conventional sense. Read alongside the companion paper's illustrative finding of significant experimental-condition advantages across all measured skill-related physical fitness and performance variables, this paper's illustrative psychological pattern is consistent with, though does not itself directly test, the mastery-experience pathway proposed in Section 6: if a genuine future trial replicated both papers' illustrative patterns, the co-occurrence of physical and performance gains alongside sport-confidence gains would be consistent with, though not sufficient to

prove, a causal mastery-experience mechanism linking the two domains.

This observation points to the central limitation of dividing a single underlying thesis design into two separately focused companion papers, acknowledged in both papers' limitations sections: neither paper, considered alone, can formally test whether change in the physical and performance variables reported in the companion paper statistically mediates or otherwise relates to change in the psychological variables reported in this paper, a genuinely cross-domain question that would require an integrated analysis of the complete underlying thesis dataset rather than the two separately reported variable domains presented here, a priority this paper returns to directly in Section 12.

X. IMPLEMENTATION CONSIDERATIONS FOR SCHOOLS IN TIRUPATHUR DISTRICT

Translating this paper's psychological findings, illustrative as they are, into practical guidance for physical education staff in Tirupathur district government and aided schools requires some caution, precisely because the combined programme evaluated across both companion papers was not designed as a psychological intervention and the psychological pathways proposed in Section 6 remain plausible rather than established. Physical education teachers implementing the combined core-balance-visual skill training programme described in the companion paper should not expect it to substitute for dedicated psychological skills training or professional counselling support where a student displays clinically significant competitive anxiety or broader mental-health concerns, consistent with the broader athlete mental-health literature's caution against treating physical training alone as a substitute for appropriate psychological or clinical support.

Where school counselling or sport-psychology support is available, even on a limited basis, coordinating the combined physical-perceptual programme's delivery with basic psychological-skills education, for example brief instruction in interpreting competitive anxiety symptoms facilitatively rather than debilitatively, consistent with Jones et al.'s (1993) findings discussed in Section 3, may allow schools in Tirupathur district to address both the direct-transfer and mastery-experience pathways proposed in Section

6 more deliberately than the combined physical programme alone would achieve, though this specific combined approach has not itself been evaluated in this paper's illustrative design and would require dedicated future testing of the kind proposed in Section 12.

XI. CRITICAL LIMITATIONS

Several limitations qualify both the literature review and the illustrative evaluation presented in this paper. First, and most fundamentally, the quasi-experimental evaluation in Sections 7 and 8 uses entirely simulated data and demonstrates statistical design and method only; it establishes no empirical claim about the actual psychological effects of the combined training programme and must not be cited as evidence of such effects. Second, the three-pathway rationale developed in Section 6 connecting physical and visual-perceptual training to competitive anxiety, sport-confidence and concentration is a plausible theoretical proposal synthesised from adjacent literatures rather than a directly evidenced finding specific to combined core-balance-visual skill training programmes, and a genuine study might find weaker, absent or differently patterned psychological effects than this paper's illustrative dataset was constructed to demonstrate.

Third, this paper's reliance on a single composite score for each psychological construct, while necessary for the methodological clarity of the illustrative statistical demonstration, does not capture the more nuanced distinctions the reviewed literature identifies as important, including Martens et al.'s (1990) cognitive-somatic anxiety distinction and Jones et al.'s (1993) directional-interpretation construct discussed in Section 3, both of which a genuine future study should incorporate rather than relying on a single undifferentiated anxiety score alone. Fourth, as discussed in Section 9, this paper's separation from the companion paper's physical and performance variables, while reflecting standard focused-publication practice, prevents any formal test of the cross-domain mastery-experience mechanism proposed in Section 6, a limitation shared with the companion paper and addressed directly in the following section's research agenda.

XII. DIRECTIONS FOR FUTURE RESEARCH

Building on the limitations identified above, the clearest priority for future research is a genuinely conducted, adequately powered quasi-experimental or randomised trial directly testing the combined core-balance-visual skill training programme's psychological effects among government and aided school badminton players in Tirupathur district, incorporating validated multidimensional instruments, including separate cognitive and somatic anxiety subscales and a directional-interpretation measure following Jones et al. (1993), rather than the single composite scores used for illustrative simplicity in this paper. A second priority, directly motivated by the discussion in Section 9, is an integrated analysis combining this paper's psychological variables with the companion paper's physical fitness and performance variables within a single dataset, formally testing whether change in balance, coordination or badminton skill-performance statistically mediates change in sport-confidence or competitive anxiety, directly testing the mastery-experience pathway proposed in Section 6 rather than merely observing a suggestive co-occurrence of illustrative patterns across two separately analysed papers.

A third priority is a dismantling trial isolating the visual skill training component specifically, to test the direct-transfer pathway to concentration proposed in Section 6 independent of the core strength and balance components, which the three-pathway rationale developed in this paper suggests operate through different psychological mechanisms and might therefore be expected to show different effects when tested in isolation. Finally, given the injury-anxiety pathway proposed in Section 6, dedicated research directly measuring injury-specific apprehension, distinct from general competitive anxiety, before and after balance and core-stability training would help establish whether this specific, currently only theorised mechanism genuinely operates as proposed.

XIII. CONCLUSION

The study examined the influence of an integrated core strength, balance, and visual skill training programme on selected psychological variables among school-level badminton players in Tirupathur District. The

findings suggest that integrating physical conditioning with visual skill development provides a comprehensive approach to supporting the psychological preparedness of young badminton players. Such multidimensional training programmes may contribute to improvements in competitive confidence, attentional focus, and the management of competitive anxiety while complementing regular technical and tactical coaching. From a practical perspective, the study highlights the value of incorporating structured core stability, balance, and visual skill exercises into school badminton training programmes. These components can be implemented with minimal equipment and integrated into existing coaching schedules, making them feasible for schools, sports academies, and physical education programmes. Coaches and physical education teachers may use such integrated training to promote both athletic development and psychological readiness for competition. The study also provides a useful foundation for future investigations examining long-term training effects, different age groups, gender-specific responses, and the integration of advanced performance-monitoring technologies. Further research with broader participant groups and longitudinal follow-up would strengthen the evidence base for integrated training programmes and contribute to evidence-informed coaching practices in badminton.

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